GROWTH RATE REVIEW ON SIX KEY FARM FORESTRY SPECIES ON KANGAROO ISLAND

INTRODUCTION

There have been a number of farm forestry sites established on Kangaroo Island (KI) over a range of rainfalls and soils including clay, sand, waterlogged and saline soils since 2002. During 2004, 2005 and 2008, PIRSA Forestry established a number of growth plots in several farm forestry locations to monitor the performance and growth rates of six tree species shown in Figure 1.

The most widely planted species are *Eucalyptus cladocalyx* (sugar gum) and *E. occidentalis* (flat-top yate). Other species planted include *Corymbia maculata* (spotted gum), *E. nitens* (shining gum), *E. punctata* (grey gum) and *E. saligna* (Sydney blue gum).

These species were selected for their potential as high value timber and their ability to cope with KI's climatic and geographic conditions. Each species has its own unique timber qualities such as density, durability and colour, which can be utilised in flooring, furniture, construction and firewood.

Figure 1, from left to right 6 yr old pruned and thinned *E. nitens,* 5 yr old pruned and thinned *C. maculata* 6 yr old pruned and thinned *E. cladocalyx*, 5 yr old *E. punctata*, 4 yr old pruned and thinned *E. occidentalis* and 5 year old pruned and thinned *E. saligna*.

Within this trial each measurement plot is approximately 0.05ha in size and contains approximately 50 trees. Rows are spaced at 4m apart and trees are planted 2.5m apart in rows.

In 2008 a number of these measurement plots were included in a KI pruning and thinning demonstration trial. This will provide future results on the effects of pruning and thinning on individual species.

The diameter at breast height over bark (DBHOB) of each tree and the predominant height in each measurement plot is measured and recorded annually. Predominant height (PDH) is the average height of the tallest 75 trees per hectare and is therefore represented by 4 measurement trees in a 0.05ha (500m^2) plot. DBHOB, PDH and an *E. globulus* volume formula have been used to calculate VO7 standing volume, which is the volume of standing timber greater than 7cm in diameter. This information indicates to growers how fast the trees are growing, which species are performing the best, and helps guide future management decisions.

STUDY SITES

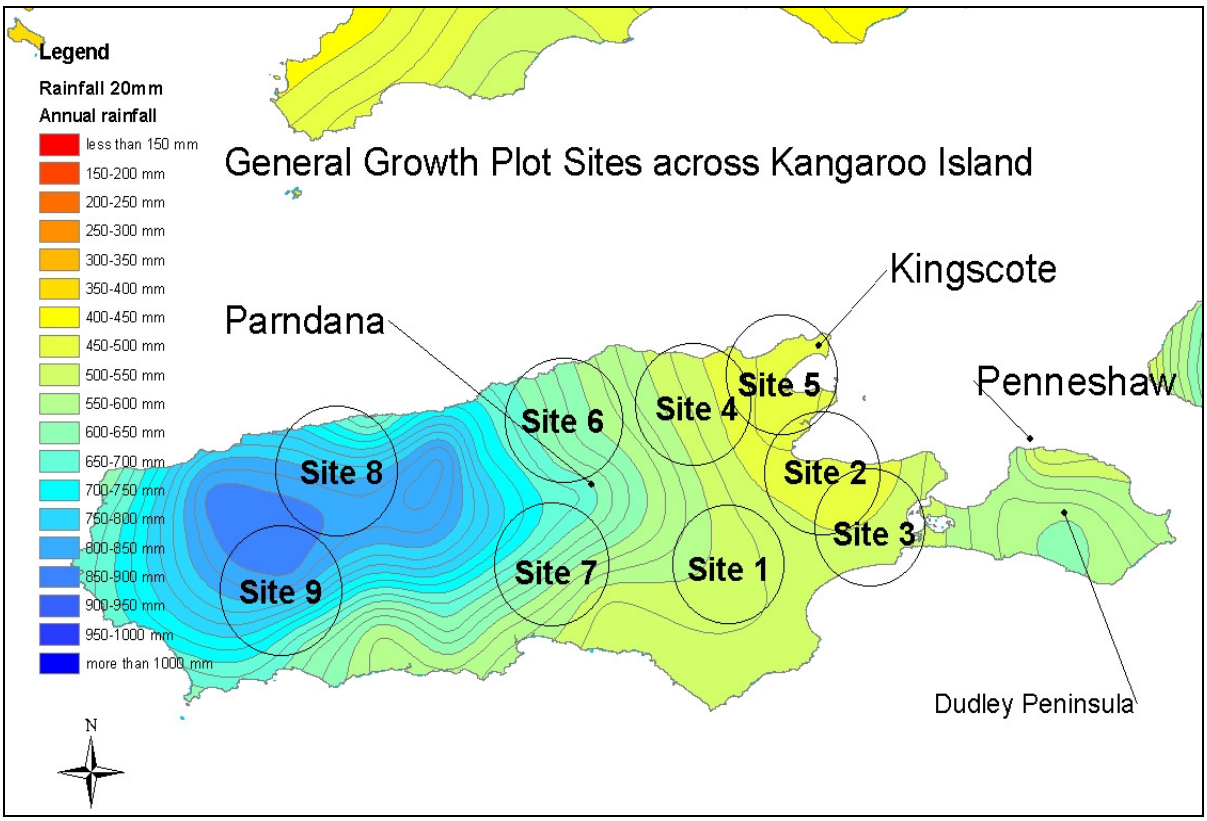

Figure 2, Location of growth plot sites in relation to annual rainfall on Kangaroo Island.

The farm forestry locations in this study are generally located in the eastern half of KI (excluding the Dudley Peninsula) in the low to medium (450-650 mm/yr) rainfall zones (Figure 2). The exceptions are *Sites 8* and *9*, located in the western half of KI in a high rainfall zone (750+ mm/yr). Site 9 was added to the measurement program in 2008 and measures the species *E. saligna*. Average rainfall, soil type, aspect and pH of each location can be seen in Table 1.

Table 1, Species, management, rainfall, soil type, pH and aspect data for each site.

Site	Species	Management	Rainfall (mm)	Soil type	Soil pH	Aspect
1	*E. occidentalis* *E. cladocalyx* *E. punctata* *C. maculata*	*E. punctata & C. maculata* Thinned & pruned 2008	500 - 550	Sandy loam with ironstone inclusions over clay	6.0	Very gentle sloping southerly aspect
2	*E. occidentalis* *E. cladocalyx* *E. punctata* *C. maculata*	*E. cladocalyx* Thinned and pruned 2008	450 - 500	Sandy loam with limestone inclusions over clay	5.5	Gentle sloping westerly aspect
3	*E. occidentalis* *E. cladocalyx*	No management undertaken	500 - 550	Sandy loam over clay with few limestone inclusions	5.5	Gentle southerly and northerly sloping aspect into a saline area
4	*E. occidentalis* *E. cladocalyx*	No management undertaken	450 - 500	Non-wetting sandy loam over clay	6.0	Flat low lying aspect
5	*E. cladocalyx*	No management undertaken	450 - 500	Loamy sand over light sandy clay	5.5	Gentle sloping westerly aspect
6	*E. occidentalis* *E. cladocalyx* *E. punctata* *C. maculata*	*C. maculata* Thinned & pruned 2008	600 - 650	Sandy loam with ironstone inclusions over clay	5.5	Flat elevated aspect
7	*E. occidentalis* *E. cladocalyx*	*E. cladocalyx* & *E. occidentalis* Thinned & pruned 2008	550 - 600	Sandy loam with gravel inclusions over clay	5.5	Gentle sloping easterly aspect
8	*E. nitens*	1 plot *E. nitens* Thinned & pruned 2008	800 - 850	Sandy loam with ironstone inclusions over ironstone gravel	6.0	Flat elevated aspect
9	*E. saligna*	*E. saligna* Thinned & pruned 2008	750 - 800	Sandy loam over gravely silt/ clay	6.5	Gentle sloping easterly aspect

It is important to note that rainfall, aspect, soil type and soil pH of individual sites (Figure 2 and Table 1) have a strong influence on the growth of forests and some tree species will perform better under certain site conditions. The quality of weed control, site preparation, site fertiliser history and management regimes also have a strong effect on the growth of forests.

KEY FINDINGS

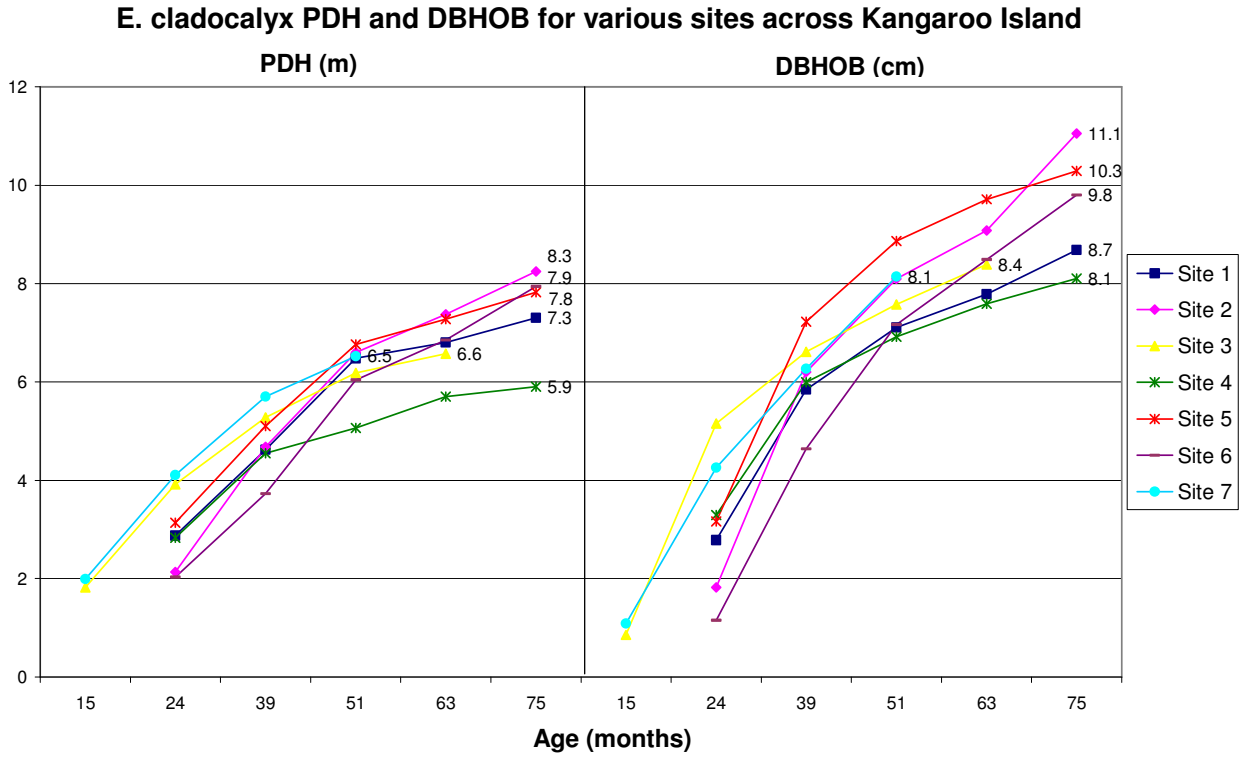

Figure 3, Comparison of PDH and DBHOB for *E. cladocalyx* at seven sites across Kangaroo Island.

There are seven study locations for *E. cladocalyx* on KI. Figure 3 shows *site 2* appears to have the most favourable site conditions for this species as there is generally better growth at this site. *Site 2* had a thinning at 69 months of age which has resulted in an increase in average tree DBHOB as the smaller trees were generally thinned, leaving a greater proportion of larger trees. *Site 2* has an average tree DBHOB of 11.1cm and PDH of 8.3m at 75 months of age.

Site 7 also had a thinning and pruning at 45 months of age and is showing a relatively high tree DBHOB of 8.1cm at 51 months of age. All other sites did not have a thinning and pruning.

Site 4 appears to be the poorest performing site with an average tree DBHOB of 8.1cm and PDH of 5.9m at 75 months of age.

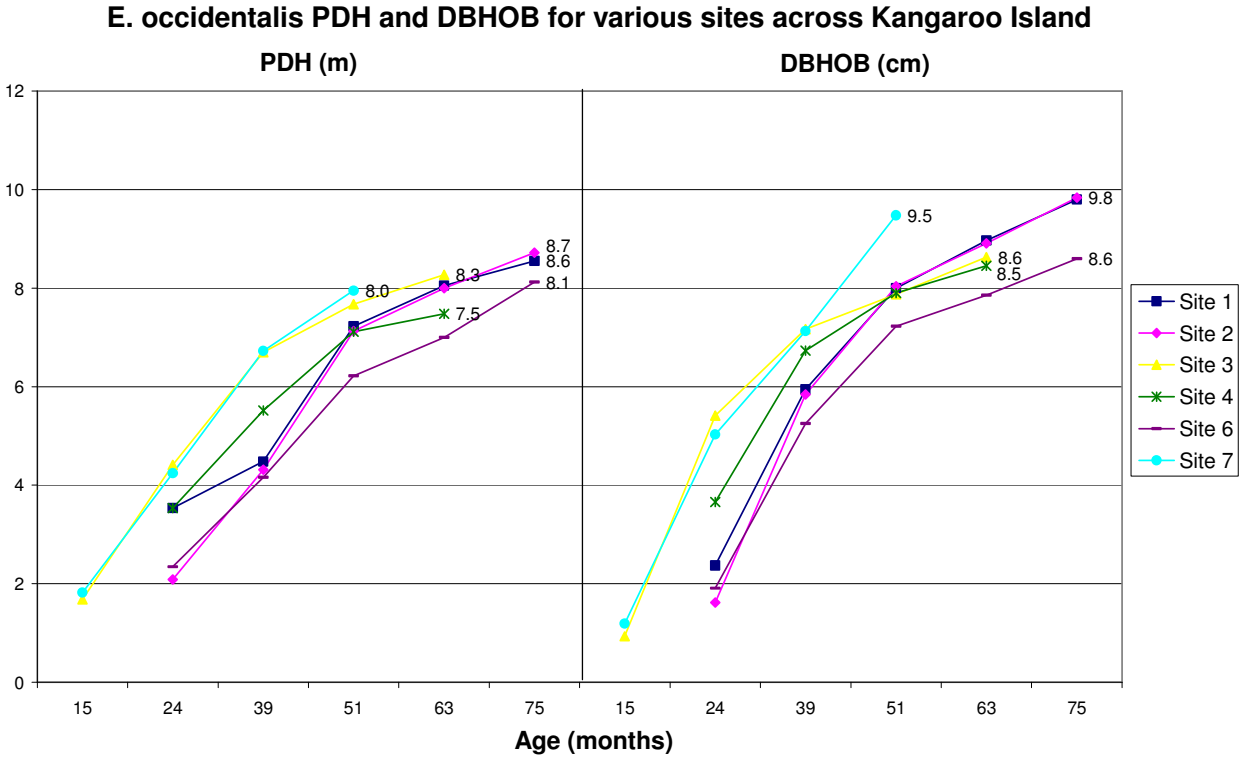

Figure 4, Comparison of PDH and DBHOB for *E. occidentalis* at six sites across Kangaroo Island.

There are six study locations for *E. occidentalis* on KI. Figure 4 shows *site 2* appears to have the most favourable site conditions for this species as there is generally better growth at this site. *Site 2* has an average tree DBHOB of 9.8cm and PDH of 8.7m at 75 months of age.

Site 7 had a thinning and pruning at 45 months of age which has resulted in an increase in average tree DBHOB values compared to other sites at 51 months of age as the smaller trees were generally thinned, leaving a greater proportion of larger trees. Site 7 has an average tree DBHOB of 9.5cm and PDH of 8.0m at age 51 months, more than 1.5 cm DBHOB than most of the other sites. All other sites did not have a thinning and pruning.

Site 6 appears to be the poorest performing site with an average tree DBHOB of 8.6cm and PDH of 8.1m at 75 months of age.

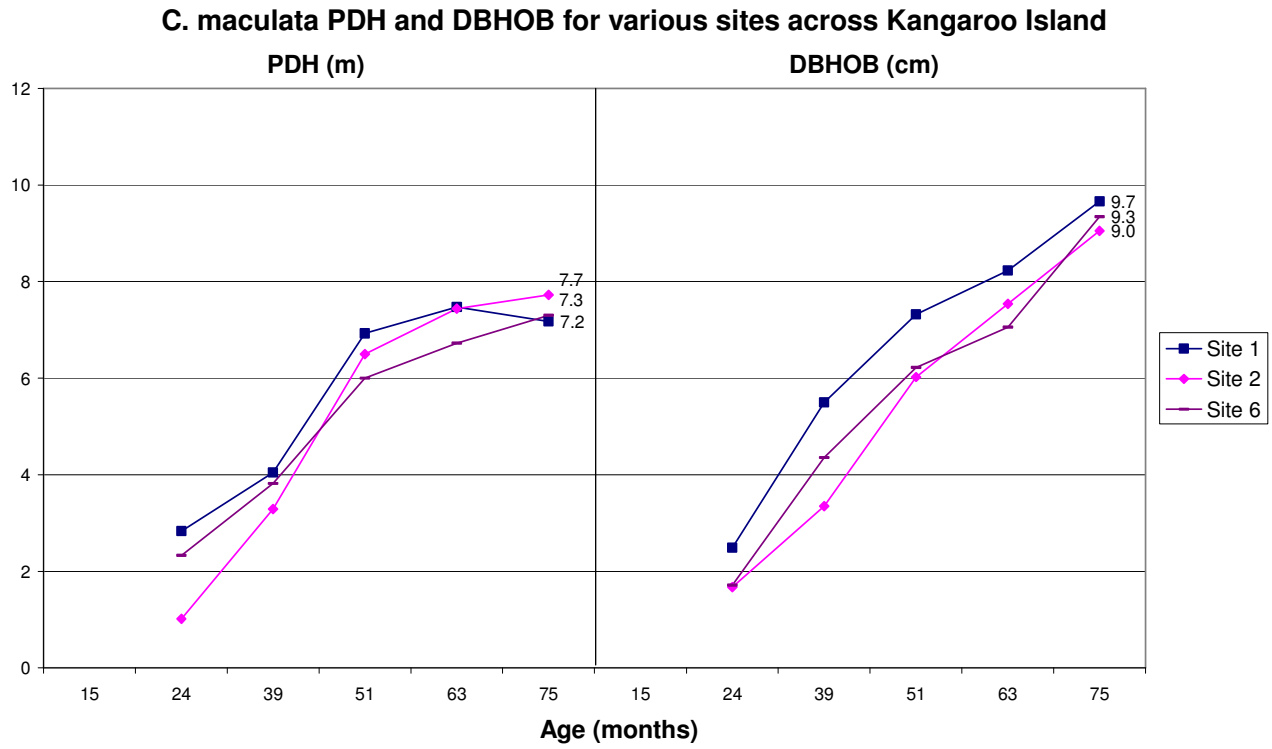

Figure 5, Comparison of PDH and DBHOB for *C. maculata* at three sites across Kangaroo Island.

There are three study locations for C. maculata on KI. Figure 5 shows *site 1* appears to have the most favourable conditions for this species as there is generally better growth at this site. *Site 1* had a thinning and pruning at 69 months of age, this resulted in a drop in PDH due to the tallest trees being thinned as they generally had the poorest form. Also as a result of the thinning there was a steep increase in average tree DBHOB as the smaller trees were generally thinned, leaving a greater proportion of larger trees. *Site 1* has an average tree DBHOB of 9.7 cm and PDH of 7.2m at 75 months of age.

Site 6 also had a thinning and pruning at 69 months of age and shows a significant increase in average tree DBHOB as a result of the thinning.

Site 2 did not have a thinning and pruning and appears to be the poorest performing site with an average tree DBHOB of 9.0cm and PDH of 7.7m at 75 months of age.

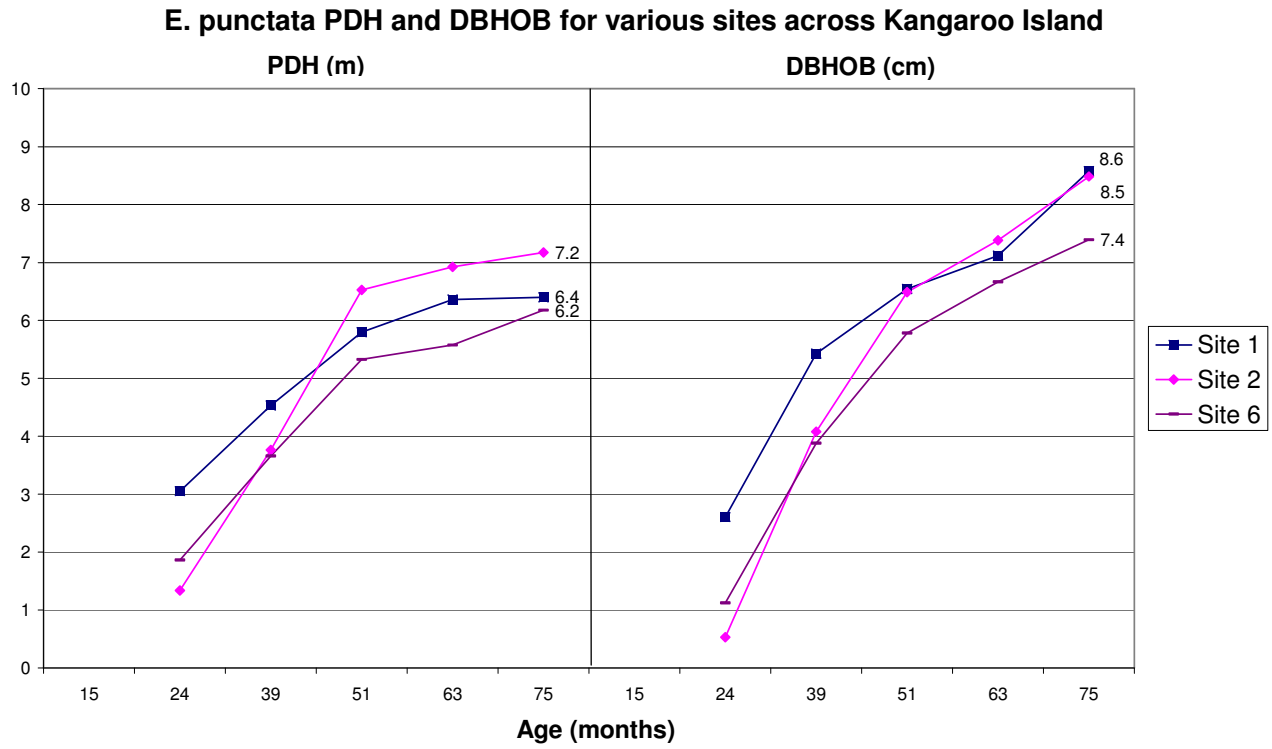

Figure 6, Comparison of PDH and DBHOB for *E. punctata* at three sites across Kangaroo Island.

There are three study locations for *E. punctata* on KI. Figure 6 shows *site 2* appears to have the most favourable site conditions for this species as there is generally better growth at this site. *Site 2* has an average tree DBHOB of 8.5cm and PDH of 7.2m at 75 months of age.

Site 1 had a thinning and pruning at 69 months of age which has resulted in a steep increase in average tree DBHOB to 8.6cm as the smaller trees were generally thinned, leaving a greater proportion of larger trees. The thinning has also resulted in a drop in PDH due to the tallest trees being thinned as they generally had the poorest form.

For *E. punctata sites 2* and *6* did not have a thinning and pruning. *Site 6* appears to be the poorest performing site with an average tree DBHOB of 7.4cm and PDH of 6.2m at 75 months of age.

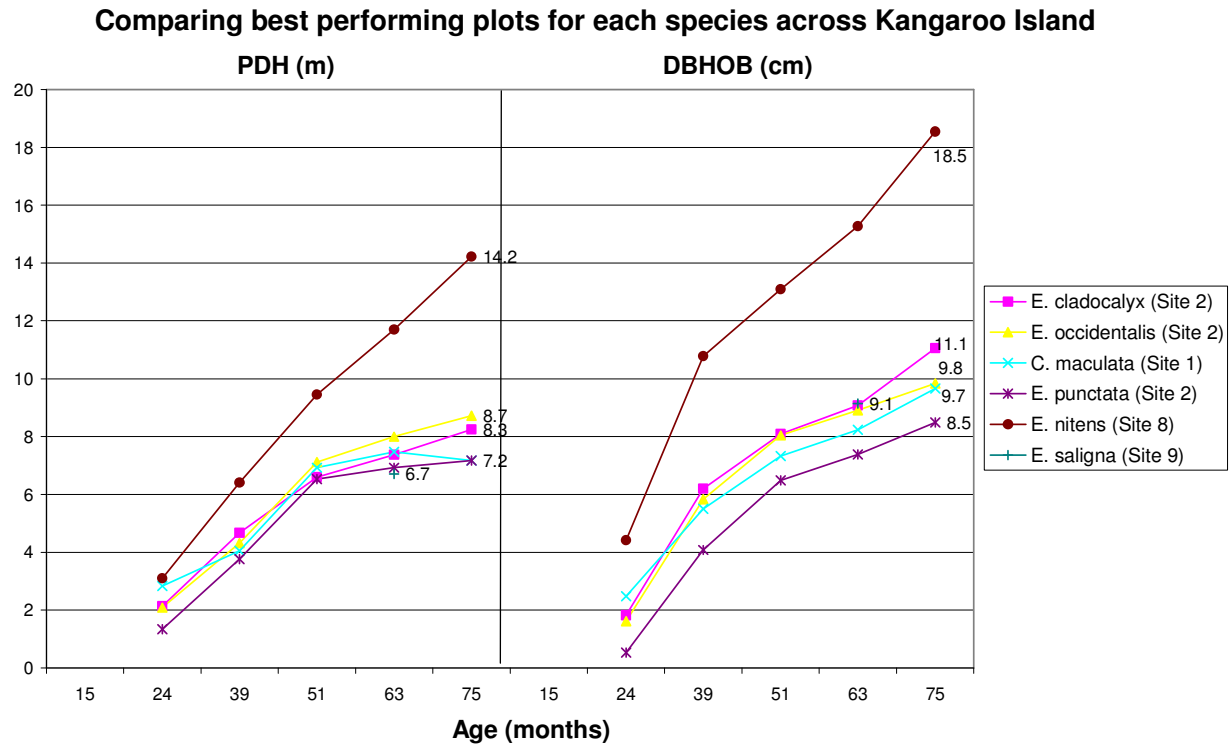

Figure 7, Comparison of PDH and DBHOB between the best growth plots of each species at 75 months of age at sites across Kangaroo Island.

Figure 7 shows that *E. nitens* at *site 8* appears to have the best growth on Kangaroo Island when compared to the other species in this report. The *E. nitens* reached an average tree DBHOB of 18.5cm and a PDH of 14.2m at 75 months of age, and are at least 5.0m taller and an average 7.0cm DBHOB greater than the other species.

The relatively steeper increases in average tree DBHOB between 63 months and 75 months for *E. cladocalyx* at *site 2* and *C. maculata* at site 1 are due to the removal of smaller diameter stems during thinning at 69 months of age.

The species with the poorest growth was *E. punctata* at site 2 with an average tree DBHOB of 8.5cm and PDH of 7.2m at 75 months of age. *E. saligna* at *site 9* had an average tree DBHOB of 9.1cm and a PDH of 6.7m at 63 months of age. This DBHOB is similar to that of 63 month old *E. cladocalyx* at *site 2* and *E. occidentalis* at *site 2*.

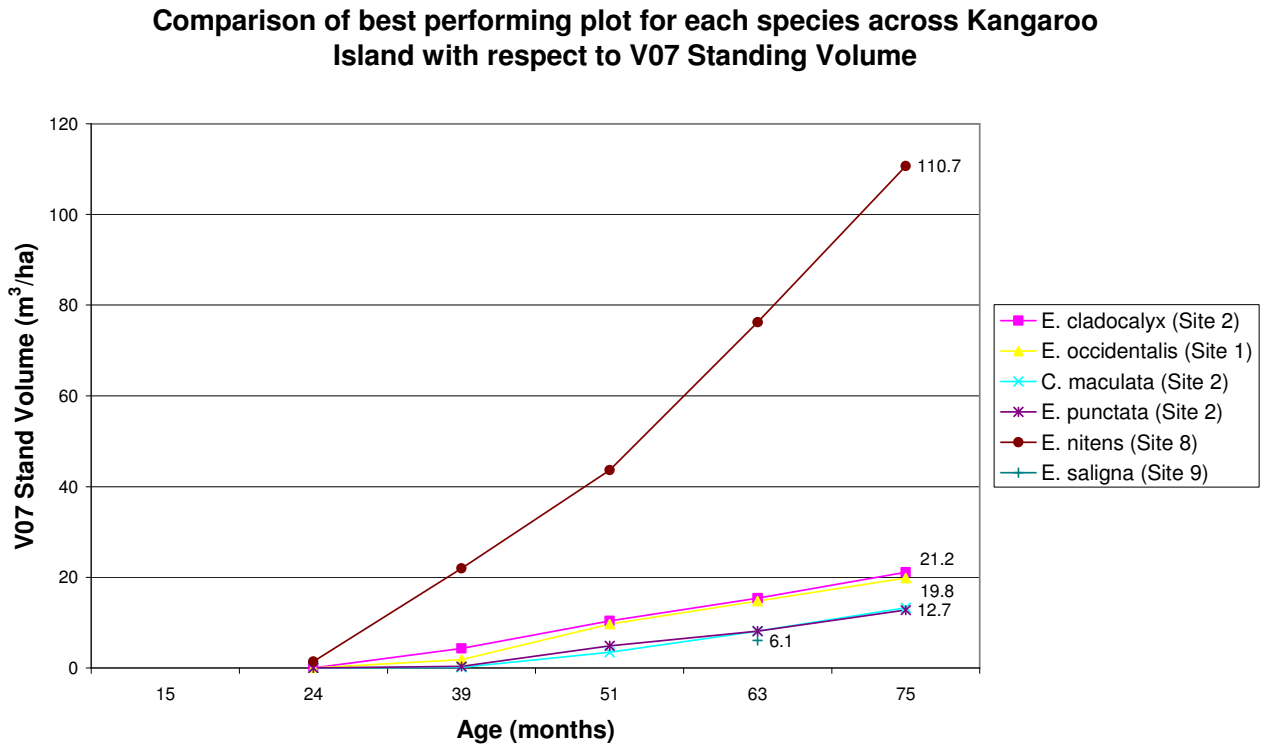

Figure 8, Comparison of V07 standing volume per hectare between the best growth plots of each species at 75 months of age at sites across Kangaroo Island.

Figure 8 shows that *E. nitens* at *site 8* produced the highest volume (110.7 m^3/ha) compared to the other five species at 75 months of age, which is a rate of about 18m^3/ha/yr. However, it is important to note that the *E. nitens* are growing in a 750+ mm/yr rainfall zone and was not included in any of the other rainfall zones due to poor suitability in lower rainfall. The high rainfall site is considered to be a major factor in *E. nitens* larger volume yield. If the other species were planted in these favourable conditions, they are likely to have produced larger volumes.

E. cladocalyx at *site 2* has shown it has the best growth across the lower rainfall sites (450 – 650 mm/yr) on KI, with the best growth plot producing a VO7 standing volume of 21.2m^3/ha at 75 months of age, which is a rate of about 3.5m^3/ha/yr. This plot is located on *Site 2* which has sandy loam over clay soil with limestone inclusions, and a gentle sloping westerly aspect. Overall, field inspections have shown that this species has a higher resistance to wallaby and possum browsing compared with other trial species. This species has shown that it can tolerate and grow well on most locations across KI.

E. occidentalis is the second best growing species on the lower rainfall sites on KI. The best performing plot was located at *site 1* which has sandy loam with ironstone inclusions over clay soil, and a very gentle sloping southerly aspect. The best *E. occidentalis* growth plot produced a VO7 standing volume of 19.8m^3/ha at 75 months of age, which is a little lower than the *E. cladocalyx* plot. This species was generally planted in low lying salt affected or waterlogged areas as it is tolerant of these conditions. It has grown well at these sites and would probably grow better in more favourable situations. Field inspections have shown that this species appears to be susceptible to browsing by possums and wallabies. This has been observed at various ages from 0 – 5 years. This has resulted in multiple stems, forking and stunted growth.

C. maculata has relatively slower growth on all sites across KI. The best *C. maculata* growth plot produced a VO7 standing volume of 12.7m^3/ha at 75 months of age. This species has shown its ability to grow in lower rainfall areas, however it would be better suited to the higher rainfall areas on KI. Field inspections have shown that this species appears to be vulnerable to browsing by wallabies and possums, as observed in trees aged from 0 – 5 years. As with *E. occidentalis*, this has resulted in multiple stems, forking and stunted growth. In addition, sheep tend not to browse low hanging foliage of this species.

E. punctata produced similar results to *C. maculata*. The best *E. punctata* growth plot produced a VO7 standing volume of 12.7m^3/ha at 75 months of age. This species has shown signs of drought stress and is looking the least healthy compared to the other trial species. *E. punctata* is bordering on its rainfall limits and would not be recommended for use in the lower rainfall sites on Kangaroo Island. This is the only species that has shown mortality in 4 – 5 year old trees due to drought conditions.

E. saligna has only recently been added to the measurement program with a measurement plot established in a recently pruned and thinned area. The plot produced a VO7 standing volume of 6.1m^3/ha at 63 months of age. This volume seems low compared to other species however this is the only thinned plot represented in *Figure 8*. A non thinned *E. saligna* plot would be expected to have a greater or equal volume to *E. cladocalyx.*

CONCLUSION

This project has shown that *E. nitens* has a growth rate of about 18m^3/ha/yr in high rainfall, and *E. cladocalyx* and *E. occidentalis* can grow better than *C. maculata* and *E. punctata* across a range of locations on KI. There is clear potential for high value hardwood timber production from these species and future measurement data will provide more information on the effects of thinning and pruning on tree and stand volume

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